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(54) Abstract Title
Forklift with light-beam assembly for fork positioning

(57) Entry-alignment of forks 22 of a forklift vehicle 10 with the aperture 28 of a load-carrying pallet 16 is controlled by the vehicle-operator using reflection 26 from the load 14 of a collimated light beam 20. The beam 20 is projected from a laser 24 aligned lengthwise with the forks 22, and the operator controls vehicle-orientation and fork-height to bring the reflection 26 to disappear from view into the aperture 28. The laser 24, which may be mounted outside the forks 22 or between them in an attached block 64 (Figures 4,5) or integral projection 86 (Figure 6), is powered from the vehicle-battery 88 (Figures 8,9) via a voltage regulator 46, or from a battery 70 attached to the fork-carriage 32. Battery power may be switched remotely under radio-frequency control.

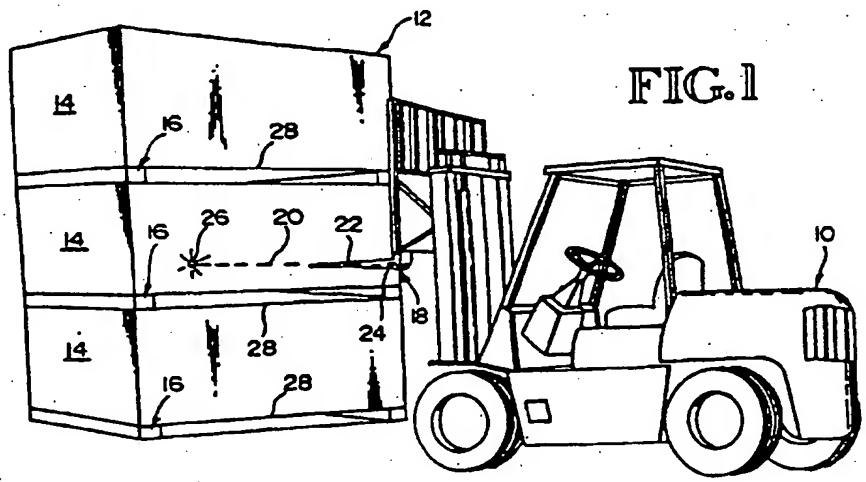

FIG. 1

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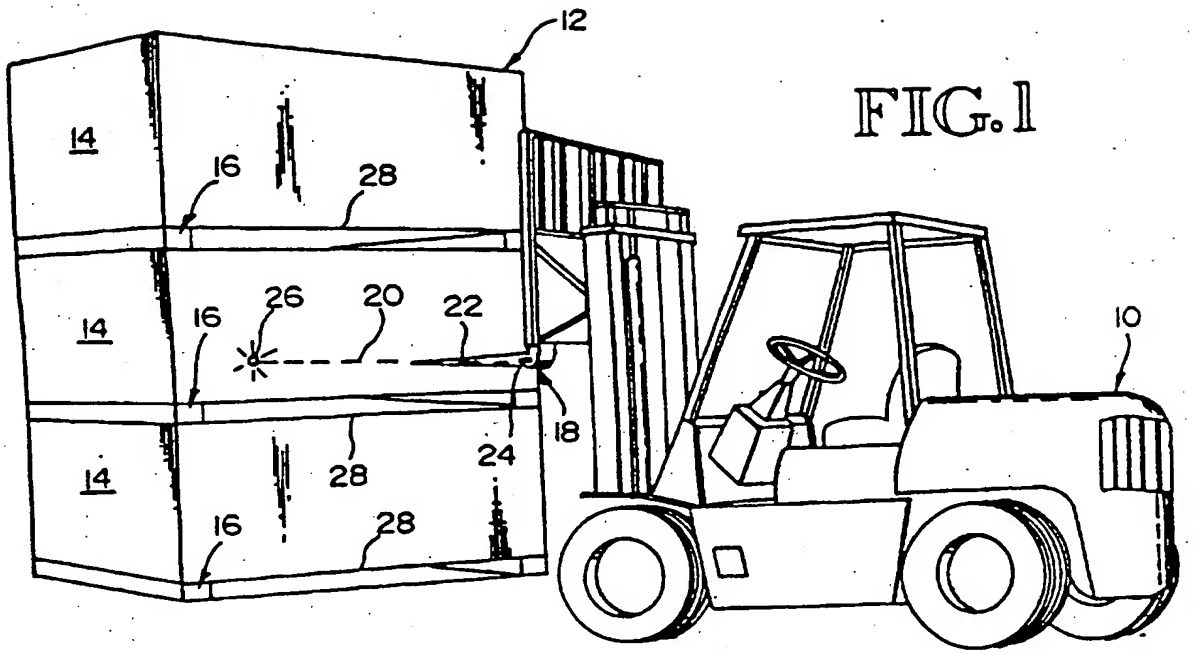
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FIG. 1

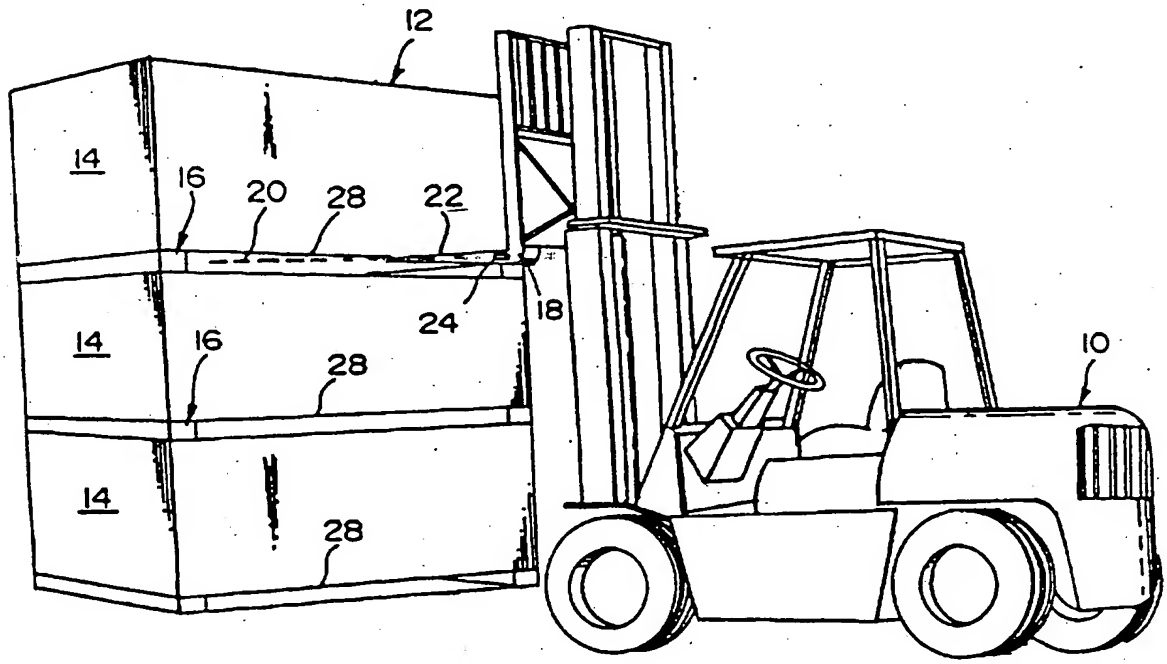
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FIG. 2

Forklifts

This invention relates to forklifts and methods of operator-control of them.

Forklifts are used extensively for handling and stacking loads carried on pallets. When lifting and carrying loads for these purposes, the one or more lifting-forks of the forklift extend under the load through an aperture beneath the upper, load-supporting platform of the pallet-structure. Entry of the one or more forks into the pallet-aperture without damaging, toppling or otherwise displacing the load, requires exercise of skill by the forklift-operator. This skill is required firstly in the task of aligning the one or more forks with the aperture, and then in the task of maintaining this alignment while the one or more forks are driven forward for clean entry under the load through the aperture. The present invention has as principal objects the provision of methods and means by which the forklift-operator may be assisted in the execution of these tasks.

According to one aspect of the present invention there is provided a method of operator-control of a forklift for entering the one or more lifting-forks of the forklift through an aperture under a load to be lifted by the forklift, wherein a substantially-collimated light beam is projected forwardly from the forklift substantially in the plane of the one or more lifting-forks for incidence on the load within the operator's field of view, the beam being visible to the operator through reflection from the load while the one or more lifting-forks deviate from entry-alignment with said aperture, and wherein the operator exercises control of the one or more lifting-forks to adjust them into entry-alignment with said aperture by changing their position to one in which

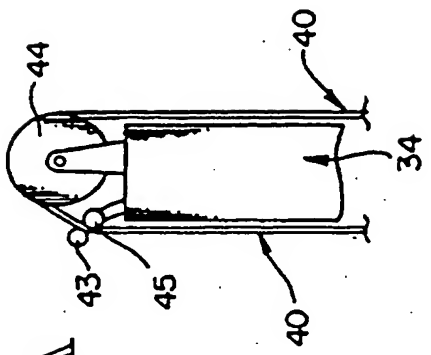
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FIG. 3A

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FIG. 3A
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FIG 3

substantially no reflection of the beam is visible to the operator in said field.

The operator may adjust the orientation of the forklift and/or its lateral relationship to the load to reduce any lateral deviation of the reflection from said aperture, and exercise control to raise or lower the one or more lifting-forks to reduce any deviation in height of the reflection from said aperture.

According to another aspect of the invention there is provided a forklift having controls for manual operation by an operator in exercising control of the one or mor lifting-forks of the forklift for entering them through an aperture under a load to be lifted by the forklift, wherein the forklift includes a light source for emitting a substantially-collimated light beam, the light source being mounted on the forklift to project the beam forwardly from the forklift substantially in the plane of the one or more lifting-forks such that incidence of the beam on a load within the field of view of the operator is visible to the operator while exercising control as aforesaid.

The light source of the method and forklift of the invention, which may be a laser light-source, may be mounted to project the light beam forwardly from the forklift substantially parallel to the one or more lifting-forks. More especially, the light source may be mounted alongside a lifting-fork of the forklift, and where the forklift has two lifting-forks it may be mounted between them.

According to a further aspect of the invention an assembly for mounting on a forklift comprises a light source for emitting a substantially-collimated light beam when powered electrically, and an elongate block for

housing the light source for emission from the block of a beam of light aligned substantially lengthwise of the block, the block being adapted for mounting on a lifting-fork of the forklift with the block aligned substantially lengthwise of the lifting-fork, the assembly being combined with an electrical battery power-supply for mounting on the forklift, selectively-operable switch means, and cabling for interconnecting the light source, the battery power-supply and the switch means for powering the light source from the battery power-supply.

A forklift vehicle, and a method of operator-control thereof in accordance with the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figures 1 and 2 show the forklift vehicle and are illustrative of successive stages in the method of operator-control of it, all in accordance with the present invention;

Figure 3 shows further features of the forklift vehicle of Figures 1 and 2;

Figure 3A shows to an enlarged scale features of the forklift vehicle that are circumscribed by broken line in Figure 3;

Figures 4 to 6 are illustrative of modified forms of the forklift vehicle of Figures 1 to 3; and

Figures 7 to 9 are schematic representations respectively of three alternative forms of electrical circuitry for use in the forklift vehicle of Figures 1 to 3.

Referring to Figures 1 and 2, the forklift vehicle 10 of the invention is illustrated in the context of lifting

and handling a stack 12 of loads 14 that are carried on individual pallets 16. An assembly 18, which is operable to emit a collimated light-beam 20, is carried with the two lifting-forks 22 of the vehicle 10. The beam 20 is emitted by a laser light-source 24 of the assembly 18 and is projected forwardly from the assembly 18 substantially parallel to, and in the same plane as, the forks 22. Accordingly, when the vehicle 10 has been manoeuvred to face the stack 12 ready for engagement of the forks 22 with one or other of the loads 14 as illustrated in Figures 1 and 2, the beam 20 is incident within the stack 12. The position where the beam 20 is incident within the stack 12 shows up in general within the field of view of the forklift-operator, as illustrated in Figure 1, as a bright and precise spot or reflection 26; the beam 20 has an intensity to ensure that the reflection 26 is clearly visible during daylight.

The location of the reflection 26 within the stack 12 is indicative to the forklift-operator of the height and lateral relationship of the forks 22 to the load 14 identified for lifting. More particularly, the operator can see from the location of reflection 26 the extent to which the forks 22 deviate from alignment with the fork-receiving aperture 28 of the pallet 16 supporting the identified load 14. Thus, the operator has clear guidance from the extent to which the reflection 26 is spaced laterally from that aperture 28 whether the orientation and/or lateral relationship of the forks 22 to the identified load 14, requires adjustment by manoeuvre of the vehicle 10. But, more especially, the deviation of the reflection 26 in height from the aperture 28 beneath the identified load 14, shows the operator how much, and in what sense, the forks 22 are to be raised or lowered to achieve entry-alignment with that aperture 28.

As the operator manoeuvres the vehicle 10 to bring the forks 22 into lateral alignment with the aperture 28, so the reflection 26 moves across the stack 12 until it reaches a location vertically above or below one end of that aperture 28 (the particular end, left or right, depends upon whether the assembly is mounted to the left or right side of the forks 22). With the reflection 26 in this location, the operator can now bring the forks 22 into alignment for entry into the aperture 28 simply by adjusting their height in the appropriate sense. When the correct height for entry-alignment is reached, the beam 20 enters the aperture 28 so substantially no reflection is visible to the operator, that is to say, the reflection 26 disappears from his/her view. Accordingly, all the operator needs to do for accurate entry-alignment is to adjust the height of the forks 22 in the appropriate sense until the reflection 26 disappears into the aperture 28.

The vehicle 10 can now be advanced towards the stack 12 to enter the forks 22 cleanly through the aperture 28 under the load 14 as a preliminary to the load-lifting procedure. If during this advance of the vehicle 10, the operator sees the reflection 26 re-appearing (for example owing to unevenness of the ground) he/she will be warned immediately by this that there is misalignment and can react rapidly to correct for it and avoid damage and/or toppling or other displacement of the load 14. From the sense and degree of the re-appearance, the operator will have immediate indication of the adjustment that needs to be made to ensure clean entry of the forks 22 into the aperture 28. The adjustment to avoid striking the load 14 or pallet 16, can be made by first stopping the vehicle 10, or as the vehicle 10 continues its advance towards the stack 12.

Further details of the vehicle 10 and the installation of the assembly 18 on it, are shown in Figure 3 and will now be described.

Referring to Figure 3, the forks 22 project from a carriage 32 that is guided conventionally for vertical movement up and down a mast 34 in accordance with operator-controlled drive from the engine 36 of the vehicle 10. Electrical cabling 40 consisting of electrically-insulated leads 42 for powering the laser light-source 24 from the battery (not shown) of the vehicle 10, extends up and over the mast 34 to the assembly 18 on the carriage 32. In extending to the carriage 32, the cabling 40 passes between two guide pulleys 43 and 45 (see Figure 3A) from a take-up spool 44 on top of the mast 34.

The electrical circuit established via the leads 42 to the laser light-source 24, includes a voltage regulator 46 which is mounted in the instrument-cluster 48 of the vehicle 10 together with an on-off toggle switch 52. The switch 52 is connected in the circuit for operation by the forklift-operator while seated on the vehicle seat 54, to switch electrical power to the laser light-source 24 on and off. The circuit may also include a motion and/or other sensor device (not shown) that is effective to switch off power to the light-source 24 when the forklift vehicle 10 is not fully operational.

Details of the mounting of the laser light-source 24, and alternative circuits for powering it, are illustrated in Figures 4 and 5 and will now be described.

Referring to Figures 4 and 5, the laser light-source 24 is located within a cylindrical bore 62 of an elongate metal housing or block 64. The block 64 is secured to a steel plate 61 which has a thickness of some 6.4 mm

(0.25 inch); the housing or block 64 may be wire-welded to the plate 61 (or, if omitting the plate 61, directly to the carriage 32). The plate 61 is welded, or bonded by adhesive, to the carriage 32 side-by-side with one of the forks 22, and the block 64 as mounted on the plate 61 extends aligned lengthwise with the fork 22. Two screws 66 hold the light-source 24 fast within the block 64 with its emitted light-beam 20 parallel to, and within the general plane of, the forks 22.

Modifications of the energising circuit of the light-source 24 are illustrated respectively in Figures 4 and 5. In Figure 4, the cabling 40 to the light-source 24, rather than extending back to the instrument-cluster 48 and being powered from the vehicle-battery, extends instead to a battery-pack 70 (rechargeable or otherwise) that is mounted on the back of the carriage 32 near the forks 22 where it will be generally free from damage during operation of the vehicle 10. An on-off toggle switch 72 is mounted with the battery-pack 70 for use in switching the light-source 24 on and off.

The further modified energising circuit of Figure 5 replaces the toggle switch 72 of Figure 4 with a radio-frequency receiver-switch 74. The receiver-switch 74 receives via its aerial 76, commands transmitted by radio-frequency signalling from a hand-operated controller 78. The controller 78 has on- and off-button switches 80 and 82 that when operated cause the receiver-switch 74 to turn the light-beam 20 on and off respectively. In this respect the modification of Figure 5 has the advantage of the arrangement of Figure 4 of simplifying installation of the assembly 18, but avoids the necessity of the arrangement of Figure 4, for the forklift-operator to leave the seat 54 to switch the light-beam 20 on and off.

The light-source 24 in the arrangements described above with reference to Figures 4 and 5 is mounted on the carriage 32 using the housing or block 64 secured as a separate item to the carriage 32. It is possible, however, to make special provision in the carriage 32 as manufactured, for mounting the light-source 24. In this respect, Figure 6 shows a modified form of carriage 32 incorporating an integral projection 86 for housing the light-source 24.

One form of laser (Class 3A) that is suitable for use as the light-source 24, requires to be powered from a three-volt electrical supply. This makes it readily possible to adopt the form of installation described above with reference to Figure 4, using a circuit as shown in Figure 7 where just the battery-pack 70 and the switch 72 are connected in series with the light-source 24. On the other hand, the light-source 24 may be powered as described above with reference to Figure 3, from the vehicle-battery using the voltage regulator 46 for stepping-down the vehicle-battery voltage to three volts; this is illustrated in Figures 8 and 9.

In the case of Figure 8, the switch 52 is connected in series with the vehicle-battery 88 beyond the regulator 46, whereas in the case of Figure 9 (which unlike Figure 8 shows the take-up spool 44 included) it is connected before the regulator 46.

The light-source 24 is shown in Figures 1 to 6 as mounted on the outside of the left-hand fork 22 of the carriage 32. It may, of course, be mounted instead on the outside of the right-hand fork 22, but mounting it on the inside of either fork 22 is also a possibility. Furthermore, although in the present example, a forklift vehicle is involved, the invention is also applicable where other

forms of forklifts are used, and also where the forklift has one lifting fork rather than a plurality.

Claims:

1. A method of operator-control of a forklift for entering the one or more lifting-forks of the forklift through an aperture under a load to be lifted by the forklift, wherein a substantially-collimated light beam is projected forwardly from the forklift substantially in the plane of the one or more lifting-forks for incidence on the load within the operator's field of view, the beam being visible to the operator through reflection from the load while the one or more lifting-forks deviate from entry-alignment with said aperture, and wherein the operator exercises control of the one or more lifting-forks to adjust them into entry-alignment with said aperture by changing their position to one in which substantially no reflection of the beam is visible to the operator in said field.

2. A method according to Claim 1 wherein the operator adjusts the orientation of the forklift and/or its lateral relationship to the load to reduce any lateral deviation of the reflection from said aperture, and exercises control to raise or lower the one or more lifting-forks to reduce any deviation in height of the reflection from said aperture.

3. A method according to Claim 1 or Claim 2 wherein the light beam is provided by a laser light-source.

4. A method according to any one of Claims 1 to 3 wherein the light beam is projected forwardly from the forklift substantially parallel to the one or more lifting-forks.

5. A method according to any one of Claims 1 to 4 wherein the light beam is projected forwardly from alongside the one lifting-fork, or from alongside one of the plurality of lifting-forks of the forklift.

6. A method according to any one of Claims 1 to 5 wherein the forklift has two lifting-forks and the light beam is projected forwardly from between them.

7. A method according to any one of Claims 1 to 6 wherein said aperture is a fork-receiving aperture of a pallet carrying said load.

8. A method according to any one of Claims 1 to 7 wherein the light source is electrically powered in dependence upon selective control via radio-frequency transmission.

9. A forklift having controls for manual operation by an operator in exercising control of the one or more lifting-forks of the forklift for entering them through an aperture under a load to be lifted by the forklift, wherein the forklift includes a light source for emitting a substantially-collimated light beam, the light source being mounted on the forklift to project the beam forwardly from the forklift substantially in the plane of the one or more lifting-forks such that incidence of the beam on a load within the field of view of the operator is visible to the operator while exercising control as aforesaid.

10. A forklift according to Claim 9 where the light source is a laser light-source.

11. A forklift according to Claim 9 or Claim 10 wherein the light source is mounted to project the light beam

forwardly from the forklift substantially parallel to the one or more lifting-forks.

12. A forklift according to any one of Claims 9 to 11 wherein the light source is mounted alongside the one lifting-fork, or alongside one of the plurality of lifting-forks of the forklift.

13. A forklift according to any one of Claims 9 to 12 wherein the forklift has two lifting-forks and the light source is mounted between them.

14. A forklift according to any one of Claims 9 to 13 wherein the light source is electrically powered and supply of power to the light source is controlled selectively via radio-frequency transmission.

15. A forklift according to any one of Claims 9 to 14 wherein the light source is electrically powered from a battery power-source, and the battery power-source is mounted on a carriage from which the one or more lifting-forks project.

16. An assembly for mounting on a forklift, comprising a light source for emitting a substantially-collimated light beam when powered electrically, and an elongate block for housing the light source for emission from the block of a beam of light aligned substantially lengthwise of the block, the block being adapted for mounting on a lifting-fork of the forklift with the block aligned substantially lengthwise of the lifting-fork, said assembly being combined with an electrical battery power-supply for mounting on the forklift, selectively-operable switch means, and cabling for interconnecting the light source, the battery power-supply and the switch means for powering the light source from the battery power-supply.

17. An assembly according to Claim 16 wherein the light source is a laser light-source.

18. A method of operator-control of a forklift for locating lifting-forks of the forklift through an aperture under a load to be lifted by the forklift, substantially as hereinbefore described with reference to the accompanying drawings.

19. A forklift vehicle substantially as hereinbefore described with reference to the accompanying drawings.